

22974

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10/509299

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DT18 Rec'd PCT/PTO 24 SEP 2004

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Ihr Zeichen

Ihre Nachricht vom

Unser Zeichen

Siegen

40 774.:sr

02.04.2004

**Internationales Aktenzeichen PCT / EP03 / 01814**  
**"Verfahren zur Behandlung von legierten kohlenstoffhaltigen**  
**Eisenschmelzen zur Herstellung von Stahl"**  
**Anmelder: SMS Demag AG**

Im Nachgang zur diesseitigen Eingabe vom 15.03.2004 werden die jeweiligen  
Computerübersetzungen der im Bescheid vom 22.12.2003 zitierten Dokumente

D1 JP-A-08 085 815

D2 JP-A-09 087 720

D3 JP-A-07 216 429

zur Akte gereicht.

Ferner wird ein neuer Anspruch 1 überreicht, der eine Merkmalszusammenfas-  
sung der ursprünglich eingereichten Ansprüche 1 und 2 darstellt. An diesen neuen  
Anspruch 1 sollen sich die ursprünglichen Ansprüche 3 bis 6 in der neuen Rei-  
henfolge 2 bis 5 anschließen.

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Dem neuen Anspruch 1 wurde die Seite 3, Absatz 4 der Anmeldungsunterlagen entsprechend angepasst.

Es wird gehofft, dass auf der Grundlage der nunmehr geltenden Anmeldungsunterlagen ein positiver Prüfungsbericht erstellt werden kann.

Patentanwälte



(Valentin)

**Anlage:**

- Computerübersetzung der Dokumente D1, D2 und D3
- Auf Austauschseiten
  - Seite 3 der Anmeldungsunterlagen
  - neue Patentansprüche 1 bis 5

## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] In decarbonization refinement of \*\* chromium molten steel, this invention relates to the refinement method of the \*\* chromium molten steel which performs reduction and decarbonization efficiently while it returns the chromic-acid ghost generated by decarbonization refinement by the cheap method and collects chromium.

[0002]

[Description of the Prior Art] Conventionally, as an decarbonization refining method of the \*\* chromium molten steel containing chromium beyond 11mass% like stainless steel, the vacuum decarburization which performs the decarbonization middle or below (for example, less than [C]0.5mass%) under reduced pressure, and the dilution decarbonizing method which blows dilution gas and lowers CO partial pressure in an ambient atmosphere are used widely. Generally the former is called a VOD process and the latter is called the AOD process and the raised bottom \*\*\*\* converter process. Each of these methods tends to advance decarbonization efficiently, suppressing oxidation loss of [Cr] among molten steel on and after the decarbonization middle. However, since oxidation of [Cr] is not avoided as [C] concentration falls, the amount of [Cr] oxidation increases.

[0003] adjustment of the oxygen supply accompanying [ as it is shown in JP,55-89417,A or JP,55-152118,A by the VOD process in order to suppress oxidation loss of [Cr] among molten steel conventionally for example, ] advance of decarbonization -- or adjustment under the vacuum of 100 or less Torrs is performed. Moreover, a method which raises the ratio of dilution gas in an AOD process with the fall of [C] concentration is taken.

[0004] By these methods, most of the role of a slag are control of a splash, and erosion control of furnace refractories, and the source of oxygen of decarbonization is the oxygen supplied as gas, or oxygen in molten steel. For this reason, among the molten steel by the supplied oxygen gas, oxidation of [Cr] is not avoided, but by this oxidation of [Cr], the chromic-acid ghost (it is written that it is general (Cr 2O<sub>3</sub>)) concentration in a slag increases, and the melting point of a slag rises rapidly. Chromic-acid ghost concentration also becomes 15 - 50mass% at the time of decarbonization termination, the melting point serves as an elevated temperature 1700 degrees C or more, and a slag forms solid phase completely.

[0005] In order to use this slag as a source of oxygen of an decarbonization reaction, to return a chromic-acid ghost and to collect [Cr(s)] conventionally, and in order to aim at the rise of the decarbonization reaction rate in the decarbonization last stage (for example, less than [C]0.1mass%), in the VOD process, increase of high-vacuum-izing and the amount of gas blowing in is aimed at. Moreover, in the AOD process, vacuum refining may be given as shown in JP,3-68713,A and JP,4-254509,A. However, by these methods, since decarbonization speed is very slow and the amount of decarbonization also has it compared with that the slag forms solid phase and the early stages of decarbonization (for example, more than [C]0.5mass%), the big effect is not acquired. [ small ] For this reason, tapping is carried out, after supplying reduction material, such as Si and aluminum, in large quantities and performing reduction refinement, in order to carry out reduction recovery of the valuable metals, such as chromium after decarbonization refinement termination and in a slag.

[0006] On the other hand, the method JP,62-243711,A and given in JP,6-73424,A is indicated as a method of solving these troubles. These methods are the methods of returning by [C] in the rough molten steel which the slag which contains a chromic-acid ghost so much was made to remain in a furnace, and newly \*\*\*\*(ed) it. However, in reduction by [C], since reduction speed is slow, sufficient effect for collecting [Cr(s)] in a chromic-acid ghost is not acquired.

[0007]

[Problem(s) to be Solved by the Invention] The technical problem of this invention is carrying out efficiently [ maintain reduction speed to a high order, and ] in the method of returning by the rough molten steel which faced carrying out tapping of the molten steel by which decarbonization refinement processing was carried out in decarbonization refinement of the \*\* chromium molten steel using the refinement container of a converter mold like AOD, and the slag which contains a chromic-acid ghost so much was made to remain in a furnace, and newly \*\*\*\*(ed).

[0008]

[Means for Solving the Problem] The place which this invention solves an above-mentioned technical problem advantageously, and is made into the summary is as follows.

(1) In decarbonization refinement of \*\* chromium molten steel using a refinement container of a converter mold like AOD An included slag is made to remain in a furnace at the time of tapping. a chromic-acid ghost which it faced carrying out tapping of the molten steel by which decarbonization refinement processing was carried out, and was generated by said decarbonization refinement processing -- more than 15mass% and less than [ 50mass% ] -- In a method of returning said chromic-acid ghost by [Si] and [C] in rough molten steel which newly \*\*\*\*(ed) [Si] concentration in molten steel from \*\*\*\*\* tuyere more than at 0.1mass% Ar, N<sub>2</sub> etc. -- a refinement method of efficient \*\* chromium molten steel using decarbonization slag characterized by supplying inert gas, and for [Si] concentration playing inert gas a top from \*\*\*\*\* tuyere, and supplying oxygen gas from a lance less than [ 0.1mass% ].

[0009] (2) A refinement method of efficient \*\* chromium molten steel using decarbonization slag given in the preceding clause (1) characterized by adjusting a flow rate of oxygen gas which plays a top and is supplied from a lance according to reduction speed by [C] of a chromic-acid ghost in a slag.

(3) A refinement method of efficient \*\* chromium molten steel using decarbonization slag given in the preceding clause (1) characterized by for temperature of rough molten steel which newly \*\*\*\* being 1400 degrees C or more, and for [Si] concentration being more than 0.2mass%, and [C] concentration being more than 1.2mass%.

[0010] (4) A refinement method of efficient \*\* chromium molten steel using decarbonization slag given in the preceding clause (1) characterized by discharging only a slag from a refinement container after reduction termination of said chromic-acid ghost, and performing decarbonization refinement of \*\* chromium molten steel continuously. This invention is explained below at details. A refinement method of \*\* chromium molten steel of this invention is the refinement production process using a refinement container of a converter mold like AOD which is illustrated to drawing 1 . In drawing 1 , perform decarbonization refinement to aim [C] concentration by \*\*, a slag containing a chromic-acid ghost generated by decarbonization refinement by \*\* is made to remain in a furnace, and tapping only of the molten steel by which decarbonization refinement processing was carried out is carried out. Subsequently, rough molten steel is newly \*\*\*\*(ed) by \*\*, reduction processing by rough molten steel of a slag made to remain in a furnace by \*\* is performed, and only a slag by which reduction processing was carried out by \*\* is discharged. \*\* Return to the then same production process as decarbonization refinement of \*\*. Therefore, it becomes the efficient refinement method by repeating \*\* to \*\*.

[0011] in addition, a in drawing -- in a furnace body and b, tuyere and e show a ladle and, as for a slag and c, f shows a slag ladle, as for molten steel and d. Efficient refinement is performed facing this invention returning a slag containing a chromic-acid ghost by rough molten steel which newly \*\*\*\*, and making [Si] live together in rough molten steel in addition to [C], and adjusting [Si] concentration according to the amount of chromic-acid ghosts, and by changing a type of gas to blow further according to [Si] concentration in rough

molten steel.

[0012] drawing 2 -- a chromic-acid ghost -- 30mass(es)% -- [C] concentration 2.0mass% in rough molten steel, [Si] concentration 0.01mass% of case is compared with [C] concentration 2.0mass% and [Si] concentration 0.30mass% of case, and rough molten steel which has temperature of about 1500 degrees C for an included slag shows time amount change of chromic-acid ghost concentration in a slag at the time of carrying out reduction processing. By making [Si] contain in rough molten steel shows that whenever [ undermoderation / of chromic-acid ghost concentration ], i.e., reduction speed, becomes large. Therefore, it is more efficient for [Si] and [C] to perform rather than it performs reduction of a slag containing a chromic-acid ghost by the [C] independent.

[0013] Chromic-acid ghost concentration before reduction at the time of performing reduction processing for 10 minutes by rough molten steel which has temperature of about 1500 degrees C for a slag which contains a chromic-acid ghost in drawing 3 , and relation of a reduction characteristic are shown. In addition, a reduction characteristic was the value which set the average of the amount of reduction in case chromic-acid ghost concentration is 50mass(es)% to 100, and carried out indexation, and [C] concentration in rough molten steel before reduction was 2.0mass(es)%, and [Si] concentration was 0.3mass(es)%. It turns out that a reduction characteristic falls [ chromic-acid ghost concentration in a slag ] rapidly more than at 50mass% from drawing 3 . Moreover, since chromic-acid ghost concentration becomes [ the amount of reduction of a chromic-acid ghost in a case of carrying out reduction processing by rough molten steel which decarbonization speed of the decarbonization last stage was small, and made a slag remain after decarbonization termination, and newly \*\*\*\*(ed) ] small less than [ 15mass% ], the cost reduction effect also becomes small.

Therefore, as chromic-acid ghost concentration in a slag made to remain in a furnace, more than 15mass% and less than [ 50mass% ] are required after decarbonization termination.

[0014] drawing 4 -- a chromic-acid ghost -- about 40 mass(es)% -- a ratio of reduction by [Si] in rough molten steel occupied in [Si] concentration and the total amount of reduction in rough molten steel at the time of performing an included slag at about 1500 degrees C, and performing reduction processing by [C] concentration about 2.0 mass(es)% rough molten steel is shown. Less than [ [Si] concentration 0.1mass% ], drawing 4 shows that a ratio of reduction by [Si] falls rapidly. An yield of CO gas generated by reduction by [C] on the other hand since the ratio of reduction by [C] is small in a field where a ratio of reduction by [Si] is high is small. That is, when oxygen gas is blown in a field where an yield of CO gas is small, it cannot be said that oxygen gas is effective in order to work to [Si] in rough molten steel, and oxidation of [Cr]. Moreover, gas blowing in from \*\*\*\*\* tuyere is effective in advancing a reaction of molten steel and a slag efficiently, it blows a top and gas spraying from a lance is effective in making it react with gas which occurs out of molten steel. therefore -- more than [Si] concentration 0.1mass% -- \*\*\*\*\* tuyere to Ar and N2 etc. -- by blowing inert gas, [Si] reduction in rough molten steel of a chromic-acid ghost in a slag is promoted. Moreover, while promoting reduction by [C] in rough molten steel of a chromic-acid ghost by blowing in of inert gas from \*\*\*\*\* tuyere, it is effective to promote a reaction ( $\text{CO} + \frac{1}{2}\text{O}_2 = \text{CO}_2$ ) with CO generated by blowing a top and passing oxygen gas from a lance, and to collect heat of reaction less than [ [Si] concentration 0.1mass% ].

[0015] drawing 5 -- a chromic-acid ghost -- about 40 mass(es)% -- relation of the amount characteristic of [Cr] oxidation by an oxygen gas flow rate and oxygen gas to the amount of decarbonization in a field is shown. [ at the time of carrying out reduction processing of the included slag [C] concentration about 2.0 mass(es)% at about 1500 degrees C by [Si] concentration about 0.3 mass(es)% rough molten steel ] [ below [Si] concentration 0.1mass% ] In addition, oxygen gas is the case where blew a top and it sprays from a lance, and an oxygen gas flow rate to the amount of decarbonization expresses an oxygen gas flow rate blown when 1kg decarbonization advanced, and the amount characteristic of [Cr] oxidation by oxygen gas

is the value which set the average of the amount of [Cr] oxidation in case an oxygen gas flow rate is 1.0 to 1.0, and carried out indexation. It can be said that the amount of decarbonization of an oxygen gas flow rate which blows a top and is supplied from a lance is desirable about 1.3 or less times in order to adjust according to reduction speed (the amount of decarbonization) by [C] of a chromic-acid ghost and to suppress oxidation of [Cr] so that drawing 5 may show.

[0016] Temperature of rough molten steel at the time of performing reduction processing for 10 minutes by rough molten steel which newly \*\*\*\*(ed) a slag which contains an about 30 mass(es)% chromic-acid ghost in drawing 6, and relation of a reduction characteristic are shown. In addition, a reduction characteristic is the value which set the average of the amount of reduction of a chromic-acid ghost in case temperature of rough molten steel is 1400 degrees C to 100, and carried out indexation. Moreover, [C] concentration in rough molten steel before reduction was 2.0mass(es)%, and [Si] concentration was 0.3mass(es)%. Since temperature of rough molten steel falls [ a reduction characteristic ] rapidly at less than 1400 degrees C so that drawing 6 may show, as a temperature, 1400 degrees C or more are desirable.

[0017] A slag which contains an about 30 mass(es)% chromic-acid ghost in drawing 7 is made to remain in a furnace, and [Si] concentration in rough molten steel at the time of performing reduction processing for 10 minutes by rough molten steel which has temperature of about 1500 degrees C which newly \*\*\*\*(ed), and relation of a reduction characteristic are shown. In addition, a reduction characteristic is the value which set the average of the amount of reduction of a chromic-acid ghost of [Si] concentration 0.20mass% of case to 100, and carried out indexation. Moreover, [C] concentration in rough molten steel before reduction was 2.0mass(es)%. Since a reduction characteristic falls, more than 0.2mass% of [Si] concentration in rough molten steel is desirable less than [ [Si] concentration 0.2mass% ], so that drawing 7 may show.

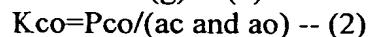
[0018] A slag which contains an about 30 mass(es)% chromic-acid ghost in drawing 8 is made to remain in a furnace, and [C] concentration in rough molten steel at the time of performing reduction processing for 10 minutes by rough molten steel which has temperature of about 1500 degrees C which newly \*\*\*\*(ed), and relation of a reduction characteristic are shown. In addition, a reduction characteristic is the value which set the average of the amount of reduction of a chromic-acid ghost of [C] concentration 1.2mass% of case to 100, and carried out indexation. Since a reduction characteristic falls, more than 1.2mass% of [C] concentration in rough molten steel is desirable less than [ [C] concentration 1.2mass% ], so that drawing 8 may show.

[0019] It is possible after reduction termination of a chromic-acid ghost in a slag to perform decarbonization refinement as it is. However, since the amount of slags increases sharply and the amount of [Cr] oxidation in molten steel also increases when decarbonization refinement is performed as it was, it is efficient to discharge only a slag from a refinement container after reduction termination of a chromic-acid ghost, and to perform decarbonization refinement continuously. as mentioned above, a chromic-acid ghost generated by decarbonization refinement processing in decarbonization refinement of \*\* chromium molten steel -- more than 15mass% and less than [ 50mass% ] -- reduction of a chromic-acid ghost is efficiently advanced by rough molten steel which an included slag was made to remain in a furnace and newly \*\*\*\*(ed) it -- being alike -- it is effective to change a class of gas blown with [Si] concentration in rough molten steel. As conditions which advance reduction still more efficiently, suitable conditions, such as concentration [in [ C ]] rough molten steel, [Si] concentration, and temperature, were drawn.

0020]

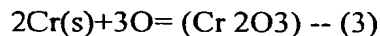
[Function] In the \*\* chromium molten steel which generally contains chromium beyond 11mass% like stainless steel, it is decarbonized to less than [ [C] concentration 0.1mass% ] by

decarbonization refinement. The decarbonization reaction in this case is expressed with (1) type, and an equilibrium constant  $K_{CO}$  is expressed with (2) types.



Here, they are  $a_C$  and  $a_O$ . CO partial pressure (atm) in an ambient atmosphere shows  $[C]$  in molten steel and the activity of  $[O]$ , and  $P_{CO}$ .

[0021] At \*\* chromium molten steel,  $[Cr]$  in molten steel is  $a_C$ . And  $a_O$  In order to make it fall, even if the oxidation of  $[Cr]$  in the molten steel shown by (3) formulas is not avoided with the fall of  $[C]$  concentration but it lowers  $P_{CO}$  like an AOD process or a VOD process, this reaction advances.



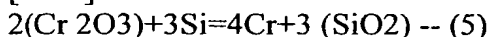
At the time of decarbonization refinement termination, concentration turns into high concentration beyond 15mass% among a slag ( $Cr_2O_3$ ), and a slag is solidified.  $[Cr]$  is a valuable metal and it is necessary to collect them. For this reason, after decarbonization termination, reduction material, such as Si and aluminum, was supplied in large quantities, and reduction refinement has been performed until now. Therefore, increase of refinement cost was caused.

[0022] As a method of solving these troubles, JP,62-243711,A and a method given in JP,6-73424,A are indicated. These methods are the methods of returning only by  $[C]$  in the rough molten steel which the slag which contains a chromic-acid ghost so much was made to remain in a furnace, and newly \*\*\*\*(ed) it. The reaction in this case is expressed with (4) types.



(4) Although the speed which is a degree whose slag is in a liquid phase condition is obtained, the reaction of a formula is very slow in the state of solid phase, and in order for reduction processing to take a long time, it is inefficient-like. Then, the method of returning a part of chromic-acid ghost in a slag as a method of canceling this trouble by  $[Si]$  in the rough molten steel shown by (5) formulas was found out.

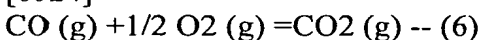
[0023]



(5) The reaction of a formula is very quick compared with the reaction of (4) types, and when  $[Si]$  and  $[C]$  are contained in rough molten steel, the reaction of (4) types advances after reaction termination of (5) types on appearance. (4) Although the reaction of a formula and (5) types is exothermic reaction, calorific value is small and, as for molten steel temperature, for a certain reason, \*\*\*\* from a furnace body also falls gradually in blowing in of only inert gas.

(4) Although CO gas is generated at the reaction of a formula, the reaction of following the (6) type advances by spraying this in oxygen gas. (6) The calorific value of the reaction of a formula is very large, and since molten steel temperature rises gradually, efficient refinement is attained.

[0024]



(6) As conditions to which the reaction of a formula is advanced efficiently, the concentration  $[in [Si]]$  rough molten steel found out blowing a top less than  $[0.1\text{mass}\%]$  and passing oxygen gas from a lance, and adjusting an oxygen gas flow rate according to the amount of decarbonization. Furthermore, the temperature of rough molten steel and conditions with a suitable presentation were found out as conditions which advance the reaction of (4) and (5) types efficiently.

[0025]

[Example] In SUS304 stainless-steel (8mass%nickel-18mass%Cr) 60ton processing, it carried out in the embodiment shown in drawing 1. All  $[C]$  concentration of the aim at the time of decarbonization refinement termination was 0.05mass(es)%, while being decarbonized to target  $[C]$  concentration, oxidation of  $[Cr]$  advanced among molten steel, and the chromic-

acid ghost concentration in a slag increased. This slag was made to remain at a furnace at the time of tapping, and the rough molten steel which newly \*\*\*\*(ed) performed reduction processing. For [Si] concentration 0.1mass%, reduction processing is Ar or N2 from \*\*\*\*\* tuyere. 2000Nm of inert gas is blown by the flow rate of 3/Hr, and, less than [ [Si] concentration 0.1mass% ], it is Ar or N2 from \*\*\*\*\* tuyere. According to the amount of reduction by [C] which played 2000Nm of inert gas 3/Hr, and a top, and measured oxygen gas beforehand from the lance, 300-2000Nm was passed in the range of 3/Hr. These reduction processings took for 10 minutes. Only the slag was discharged after reduction processing and decarbonization refinement of rough molten steel was carried out succeedingly.

[0026] The conditions of an example are shown in a table 1. The example of this invention was carried out so that the conditions which gas blowing-in conditions and conditions, such as a presentation of rough molten steel, showed previously might be satisfied. No.7 of the example of a comparison are the example performed according to the method given in JP,62-243711, A currently performed as a conventional method, in order that No.8 of the example of a comparison may return the chromic-acid ghost in a slag after termination of decarbonization refinement, after adding Si and performing reduction processing, it is the example which carried out tapping of molten steel and the slag to coincidence, and the conditions of processing of No.9-No.11 of the example of a comparison are the examples besides the condition of this invention.

[0027] An operation result is shown in a table 2. The value in a table is a value which set the result of No.7 of the example of a comparison to 100, and carried out proportionality conversion altogether. Although the big difference does not appear in refinement time amount and refinement cost in the example of this invention since it is carrying out on the conditions which promote reduction of the chromic-acid ghost in a slag, refinement cost has become very high in the example of No.8 especially in the example of a comparison.

[0028]

[A table 1]

[0029]

[A table 2]



[0030]

[Effect of the Invention] According to this invention method, in refinement of \*\* chromium molten steel, since the sharp fall of Si material unit for reduction and a dilution gas material unit can be aimed at, and reduction of a chromic-acid ghost is promoted and compaction of refinement time amount can be aimed at, sharp reduction of refinement cost is attained. Furthermore, since the temperature control of the rough molten steel at the time of reduction becomes possible, decarbonization refinement after reduction processing can be performed efficiently. Moreover, after decarbonization refinement termination, since a slag is made to remain in a furnace, the amount of slag involvement to the inside of molten steel reduces it, and its quality of a product improves.

[Claim(s)]

[Claim 1] In decarbonization refinement of \*\* chromium molten steel using a refinement container of a converter mold like AOD An included slag is made to remain in a furnace at the time of tapping. a chromic-acid ghost which it faced carrying out tapping of the molten steel by which decarbonization refinement processing was carried out, and was generated by said decarbonization refinement processing -- more than 15mass% and less than [ 50mass% ] -- In a method of returning said chromic-acid ghost by [Si] and [C] in rough molten steel which newly \*\*\*\*(ed) [Si] concentration in molten steel from \*\*\*\*\* tuyere more than at 0.1mass% Ar, N<sub>2</sub> etc. -- a refinement method of efficient \*\* chromium molten steel using decarbonization slag characterized by supplying inert gas, and for [Si] concentration playing inert gas a top from \*\*\*\*\* tuyere, and supplying oxygen gas from a lance less than [ 0.1mass% ].

[Claim 2] A refinement method of efficient \*\* chromium molten steel using decarbonization slag according to claim 1 characterized by adjusting a flow rate of oxygen gas which plays a top and is supplied from a lance according to reduction speed by [C] of a chromic-acid ghost in a slag.

[Claim 3] A refinement method of efficient \*\* chromium molten steel using decarbonization slag according to claim 1 characterized by for temperature of rough molten steel which newly \*\*\*\* being 1400 degrees C or more, and for [Si] concentration being more than 0.2mass%, and [C] concentration being more than 1.2mass%.

[Claim 4] A refinement method of efficient \*\* chromium molten steel using decarbonization

slag according to claim 1 characterized by discharging only a slag from a refinement container after reduction termination of said chromic-acid ghost, and performing decarbonization refinement of \*\* chromium molten steel continuously.

JP 09 087720 A

## Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] Especially this invention uses much more improvement in refinement efficiency as a drawing wax by utilizing a recycle slag effectively while it sets the valuable metal in a slag about the decarbonization refinement method of \*\* chromium molten steel to the non-reduction or \*\*\*\*\* which does not carry out reduction recovery and reduces the amount of Cr oxidation under refinement.

[0002]

[Description of the Prior Art] Generally, in decarbonization refinement of \*\* chromium molten steel, reduction recovery of the chromic-acid ghost which carried out oxidation generation during blowing is carried out into steel with reducing agents, such as aluminum and FeSi, after blowing termination. Moreover, like this inventing method, a reducing agent is not used but there is also the method of carrying out recycle use of the slag containing a chromic-acid ghost at next decarbonization refinement or melting reduction refinement of a chrome ore. \*\* -- as the recycle method [ like ], the method of a publication is in JP,7-62413,A, JP,62-243711,A, and JP,2-232312,A.

[0003] The method of given in JP,7-62413,A and JP,62-243711,A in this makes a non-returned slag remain in a furnace after decarbonization refinement termination, and carries out reduction recovery during high carbon concentration operation of a next decarbonization refinement production process by the reaction of degree type  $(Cr\ 2O_3) + 3[C] = 2[Cr] + 3\ CO$ .

[0004]

[Problem(s) to be Solved by the Invention] However, by the above-mentioned method, the increment in the amount of chromic-acid-izing was caused with the increment in a slag, and it had left the problem at the place where the oxidation loss of chromium increases as a result and to say. Moreover, when recycled in next charge or a next melting reducing furnace, without returning the \*\* chromium slag after decarbonization refinement, it had left the problem at the place referred to as being hard to produce the reaction of an upper \*\* type.

[0005] In order that this invention may prevent increase of the amount of chromic-acid-izing accompanying the increment in the amount of slags in the non-reduction or \*\*\*\*\* which does not carry out reduction recovery of the chromium in the slag which it was developed that the above-mentioned problem should be solved advantageously, and was generated by decarbonization refinement \*\* By the thing which reduces the amount of slags and for which the reaction between slag-metal shown more in degree type  $(Cr\ 2O_3) + 3[C] = 2[Cr] + 3\ CO$  as low basicity also in the amount of \*\* same slags is promoted While reducing effectively the amount of chromic-acid-izing under decarbonization refinement, advantageous improvement in Cr yield in molten steel in non-reduction is aimed at by promoting the reduction reaction of a recycle slag.

[0006]

[Means for Solving the Problem] Namely, after carrying out decarbonization refinement of the \*\* chromium molten steel within a container which blows this invention on refinement gas and offers a function or raised bottom \*\*\*\* both functions, In an decarbonization refinement method of \*\* chromium molten steel which carries out after tapping of having \*\*\*\*\* (ed) without carrying out reduction recovery of the valuable metal in a slag An amount  $(CaO+SiO_2)$  under blowing It is the decarbonization refinement method (the 1st invention) of \*\* chromium molten steel characterized by adjusting the amount of addition flux so that it may become below 50 kg/t.

[0007] Moreover, after carrying out decarbonization refinement of the \*\* chromium molten steel within a container which blows this invention on refinement gas and offers a function or raised bottom \*\*\*\* both functions, A slag which \*\*\*\*\* (ed) without carrying out reduction

recovery of the valuable metal in a slag, which carried out after tapping and which was generated by this charge. It sets in this container to a part or an decarbonization refinement method of \*\* chromium molten steel which is made to carry out a whole-quantity residual and is used for next decarbonization refinement. An amount (CaO+SiO<sub>2</sub>) under next blowing. It is the decarbonization refinement method (the 2nd invention) of \*\* chromium molten steel characterized by adjusting the amount of addition flux, and/or the amount of residual slags so that it may become below 50 kg/t.

[0008] Furthermore, it sets to the 1st or 2nd above-mentioned invention, and this invention is slag basicity (CaO/SiO<sub>2</sub>) further. 0.8-2.5. It is the decarbonization refinement method (the 3rd invention) of \*\* chromium molten steel adjusted to a range.

[0009]

[Embodiment of the Invention] In decarbonization refinement of \*\* chromium molten steel, the activity of C falls by Cr in steel, and Cr oxidation arises in deC and coincidence. Cr oxidation rate = oxidation Cr generation rate (1) - oxidation Cr reduction speed (2) --- (3)  
 $2[\text{Cr}] + 3/2 \text{O}_2 = (\text{Cr}_2\text{O}_3) \text{ --- (1) } + 3[\text{C}] = 2[\text{Cr}] + 2 \text{CO} (\text{Cr}_2\text{O}_3) \text{ --- (2)}$   
 Cr oxidation under decarbonization. As shown in (3) types, Cr oxidizes with the supplied oxygen gas. (2) to which the chromic-acid ghost which oxidized with the reaction of (1) type is returned by [C] among steel. It is decided by balance of the reaction of a formula. Before long Reaction rate of (2) types  $d[\text{Cr}]/dt = -A/V - k - [(\% \text{Cr}) - e (\% \text{Cr})]$

It can express.

Here, A:slag metal reaction interface product V:velocity constant [ bath volume k:reduction ]  
 ( ) [ ] expresses the inside of a slag and metal, respectively.

[0010] When the amount of slags increases (1) type generated. (Cr<sub>2</sub>O<sub>3</sub>) That is, result with which it is diluted since Cr concentration in a slag has many amounts of slags, The reaction rate of (2) types becomes small., The sake (3) types, When the chrome oxide generation rate shown by (1) formula is fixed, the amount of Cr oxidation increases. The slag in decarbonization refinement is . It consists of CaO and SiO<sub>2</sub>. SiO<sub>2</sub> amount is decided by SiO<sub>2</sub> generated from Si in the molten iron under blowing, or Si in a FeCr alloy, and SiO<sub>2</sub> contained in the ash content of a corks name. Again CaO is decided by the amount of glow lime supplied to it.

[0011] Now, artificers repeated the experiment paying attention to the amount of slags at the time of refinement that decarbonization refinement which does not cause increase of the amount of chromic-acid-izing should be realized. Consequently, as shown in drawing 1 , the amount of slags is conversion (CaO+SiO<sub>2</sub>). When it was below 50 kg/t, the knowledge of being able to stabilize and maintain the amount of Cr oxidation to lower order was acquired. Therefore, the amount (CaO+SiO<sub>2</sub>) under blowing in the 1st invention It decided to adjust the amount of addition flux so that it may become below 50 kg/t. Moreover, in the 2nd invention, the amount (CaO+SiO<sub>2</sub>) under next blowing It decided to adjust the amount of addition flux, and/or the amount of residual slags so that it may become below 50 kg/t. However, it is even if few since the increment in generating of SUROPPINGU or dust will become remarkable, if there are too few amounts of slags. As for 20 kg/t degree, it is desirable to make it exist.

[0012] moreover, artificers receive SiO<sub>2</sub> generated amount, as shown in drawing 2 the amount of CaO(s) -- namely, -- In whenever [ low-salt radical / with small CaO/SiO<sub>2</sub> ratio ], the slag softened and the direction which performs decarbonization refinement mentioned above. Since the reaction of (2) types is promoted They found out collectively that much more reduction of the amount of Cr oxidation was attained, i.e., effect with much more making basicity low also in the amount of the same slags is also acquired. It is basicity (CaO/SiO<sub>2</sub>) so that more clearly than this drawing. When it was 2.5 or less, in the amount of the same slags, the amount of Cr oxidation was able to be reduced effectively. Thus, CaO/SiO<sub>2</sub> Since the liquid phase of a slag increased, the reason for the ability to attain effective reduction of the amount of Cr oxidation by depending or less with 2.5 is considered. To drawing 3 , it can set

under Cr<sub>2</sub>O<sub>3</sub> existence. Although the relation between CaO/SiO<sub>2</sub> ratio and the liquid phase ratio of a slag was shown, CaO/SiO<sub>2</sub> ratio If it becomes 2.5 or less, the liquid phase ratio of a slag will rise rapidly. However, CaO/SiO<sub>2</sub> ratio Since consumption of refractories will become remarkable as shown in drawing 4 if less than 0.8, it is CaO/SiO<sub>2</sub> ratio. 0.8-2.5 It limited to the range.

[0013]

[Example] Decarbonization refinement conditions are as being shown in a table 1.

[A table 1]

ヒートサイズ	150～160 ton/ch			
上吹きガス	O <sub>2</sub> , N <sub>2</sub> (1～2 Nm <sup>3</sup> /min/t)			
底吹きガス	O <sub>2</sub> , O <sub>2</sub> + Ar, O <sub>2</sub> + N <sub>2</sub> (0.8～1.5 Nm <sup>3</sup> /min/t)			
最終Cr濃度	16～18 %			
装入粗溶鋼	〔%C〕	4.5～5.0	〔%Cr〕	5～7
	温度	1450～1500 °C		
副原料	焼石灰	0～50 kg/t		
	コークス	0～30 kg/t		
	FeCr	110～130 kg/t		
吹止め	〔%C〕	0.08～0.12		
	温度	1700～1750 °C		

[0014] in this decarbonization refinement, various the amounts of residual slags are boiled, and are changed, and the result investigated about the relation between the amount (CaO+SiO<sub>2</sub>) under blowing and the amount of Cr oxidation is shown in drawing 1. The amount (CaO+SiO<sub>2</sub>) under blowing so that more clearly than this drawing When it was below 50 kg/t, the amount of Cr oxidation was able to be stopped low. Moreover, although the result investigated about the effect of the basicity (CaO/SiO<sub>2</sub>) exerted on the relation between an amount (CaO+SiO<sub>2</sub>) and the amount of Cr oxidation was shown in drawing 2, basicity so that clearly from this drawing When it became 2.5 or less, the liquid phase ratio of a slag increased, and the amount of Cr oxidation was able to be reduced also in the amount of the same slags.

[0015]

[Effect of the Invention] In the non-reduction or \*\*\*\*\* which does not carry out reduction recovery of the slag after decarbonization refinement in this way according to this invention Slag under blowing (CaO+SiO<sub>2</sub>) Amount It restricts to below 50 kg/t and is slag basicity further  $0.8 \leq \text{CaO/SiO}_2 \leq 2.5$  By controlling in a range Without causing the increment in refractories consumption, it is stabilized and the amount of Cr oxidation under decarbonization can be maintained to lower order. Consequently, since the oxidation loss of

chromium was sharply reduced compared with the former, Cr yield improved, and the stability of operation also became possible by the amount presumption of Cr oxidation.

[Claim(s)]

[Claim 1] After carrying out decarbonization refinement of the \*\* chromium molten steel within the container which blows on refinement gas and offers a function or raised bottom \*\*\*\* both functions, it sets to the decarbonization refinement method of the \*\* chromium molten steel which carries out after tapping of having \*\*\*\*\* (ed), without carrying out the reduction recovery of the valuable metal in a slag, and the amount (CaO+SiO<sub>2</sub>) under blowing The decarbonization refinement method of the \*\* chromium molten steel characterized by to adjust the amount of addition flux so that it may become below 50 kg/t.

[Claim 2] After carrying out decarbonization refinement of the \*\* chromium molten steel within a container which blows on refinement gas and offers a function or raised bottom \*\*\*\* both functions, A slag which \*\*\*\*\* (ed) without carrying out reduction recovery of the valuable metal in a slag, which carried out after tapping and which was generated by this charge It sets in this container to a part or an decarbonization refinement method of \*\* chromium molten steel which is made to carry out a whole-quantity residual and is used for next decarbonization refinement. An amount (CaO+SiO<sub>2</sub>) under next blowing An decarbonization refinement method of \*\* chromium molten steel characterized by adjusting the amount of addition flux, and/or the amount of residual slags so that it may become below 50 kg/t.

[Claim 3] It sets to claims 1 or 2, and is slag basicity (CaO/SiO<sub>2</sub>) 0.8-2.5 An decarbonization refinement method of \*\* chromium molten steel adjusted to a range.

JP 07 216429 A

## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Industrial Application] It is related with the manufacture method of the stainless steel rough molten steel characterized by carrying out the waste of the slag collected [ chromium ], and carrying out decarbonization refinement at the same furnace succeeding after this invention returns a part for the chrome oxide in the decarbonization slag generated by front charge in refinement with a converter mold reaction container with the molten iron of degree charge.

[0002]

[Description of the Prior Art] There is \*\* chromium melted iron ingoted with the electric furnace as a raw material for refining the molten steel containing chromium using the shaft furnace molten iron dephosphorized and desulfurized by refinement furnace outside, the \*\* chromium molten iron generated by melting reduction of a chrome ore, and a stainless steel scrap. These raw materials are falling to the carbon concentration which fulfills a quality-of-the-material property by carrying out \*\*\*\* decarbonization refinement by the top-blown rotary converter, the \*\*\*\*\* converter, the raised bottom \*\*\*\* converter, and AOD, and carrying out \*\*\*\* decarbonization refinement at VOD or a vacuum-refining furnace called RH-alumnus further depending on the case.

[0003] However, in these refinement furnaces, carrying out reduction recovery of the chrome oxide generated during \*\*\*\* decarbonization at the time of \*\*\*\* termination using reducing agents, such as Fe-Si, is performed widely. Since this reducing agent has the high price, the attempt for which chromic-acid-ization in \*\*\*\* is reduced as much as possible is made. For example, at JP,61-3815,A or JP,61-19716,A, the refinement method which controlled oxidation of chromium is indicated by controlling the oxygen transmission speed and the stirring force under blowing proper. However, even if it uses these methods, the amount of the reducing agent used cannot be made into zero.

[0004] On the other hand, with the plain steel which does not contain chromium, the method of using the slag generated by decarbonization as a dephosphorization agent of the molten iron removal treatment of phosphorus performed with a converter mold reaction container is shown by JP,63-195209,A. however, the oxide generated by decarbonization refinement of high chrome steel to being effective as a dephosphorization agent since FeO generated by decarbonization refinement of plain steel is easily returned with the carbon in molten iron even if it is low temperature -- Cr 2O3 of difficulty reducibility A sake it is -- Cr 2O3 In the state of low temperature, even if it was molten iron of the concentration near carbon saturation, it could not return, but there was a problem that it could not use as a dephosphorization agent. Moreover, since the so-called bumping in which the generating reaction of explosive CO gas arises and insertion molten iron disperses at the time of molten iron insertion since reactivity is good happened, the high slag of FeO had a problem on safety.

[0005] By the way, when dephosphorization is carried out by refinement furnace outside and it aims only at reduction of a chromic-acid ghost, it is equivalent to the melting reduction technology in the converter mold reaction container of a chromic-acid ghost, and such technology is shown by JP,60-9815,A and JP,1-215913,A. This method adds a chrome ore and charcoal material continuously under the conditions controlled to the specific slag presentation. However, in order [ that the chromic-acid ghost concentration contained in a slag is very low as compared with decarbonization slag, and the fluidity of a slag is high and in order to use a lot of charcoal material for reduction ], Molten iron had the feature that carbon runs at speed also with the quick reduction by near and molten iron to saturated concentration, and reduction on the conditions in which it is the carbon partial saturation in the slag condition which does not have a fluidity highly [ chromic-acid ghost concentration ], and the charcoal material in a slag does not exist had the problem that it could not do, with this technology.

[0006] Moreover, as the recovery use method of the chromium from \*\* chrome steel slag, the cooling solidification of the remnants of \*\* chrome steel is carried out, and the method of adding solid-state remnants at the time of blowing of other charges for \*\* chrome steel in a converter is shown by JP,53-119210,A. However, since the cooling solidification of the remnants of \*\* chrome steel is carried out, although bumping at the time of molten iron insertion is avoidable by this method In order for a reaction to hardly have advanced at the time of low temperature, but to have advanced the reduction reaction and to have collected parts for the chromium of the amount of aims, molten iron temperature

and slag temperature needed to be raised to a certain amount of temperature, and there was a problem of having originated in this and causing extension of remarkable refinement time amount, i.e., the fall of productivity.

[0007]

[Problem(s) to be Solved by the Invention] The problem that this invention cannot make zero the expensive amount of the reducing agent used with the technology indicated by JP,61-3815,A and JP,61-19716,A, With the technology currently indicated by JP,63-195209,A The oxide which the problem on the safety of bumping is upwards, and is generated by decarbonization refinement of high chrome steel Cr 2O<sub>3</sub> of difficulty reducibility it is -- a sake -- molten iron -- easy -- returning -- not having -- as a dephosphorization agent -- it cannot use -- \*\* -- saying -- a problem -- and by the method currently indicated by JP,60-9815,A or JP,1-215913,A Chromic-acid ghost concentration by the carbon partial saturation in the slag condition which does not have a fluidity highly And the problem that reduction on the conditions to which charcoal material does not exist in a slag cannot be performed, By the method furthermore shown by JP,53-119210,A, the problem of causing extension of remarkable blowing time amount is solved, and it aims at offering the manufacture method of stainless steel rough molten steel using efficient decarbonization slag.

[0008]

[Means for Solving the Problem] A place which this invention solves said technical problem and is made into the summary By facing melted iron containing chromium carrying out decarbonization refinement with a converter mold reaction container, and supplying charcoal material in a furnace, while decarbonization slag containing a chromic-acid ghost generated by front charge had been made to remain in a furnace Chromic-acid ghost (Cr 2O<sub>3</sub>) concentration in decarbonization slag is made into 20% or less. And where heat retaining of the temperature of decarbonization slag is carried out to 1400-1700 degrees C, molten iron of degree charge with a temperature of 1500 degrees C or less is inserted in. After carrying out \*\*\*\* temperature up refinement and returning a part for chromium in said decarbonization slag, the waste of the slag collected [ chromium ] is carried out, and it is in a manufacture method of stainless steel rough molten steel using decarbonization slag characterized by performing decarbonization refinement, dissolving a ferrochrome alloy at the same furnace succeedingly.

[0009] When long duration is taken to insert in molten iron of degree charge here and temperature of decarbonization slag falls to less than 1400 degrees C, it is effective by blowing a top after charcoal material addition, performing \*\*\*\*, and burning charcoal material to hold temperature of decarbonization slag before molten iron insertion at 1400-1700 degrees C. Moreover, while making molten steel of 1000kg / (ton-Slag) following remain in a furnace to 1t (decarbonization slag) of generation slags after front charge tapping A component of decarbonization slag containing a chromic-acid ghost generated by front charge is CaO/SiO<sub>2</sub>. [ whether 1.0-3.0, and MgO are 15% or less and ] Or CaO/SiO<sub>2</sub> 3.0-4.0, and aluminum 2O<sub>3</sub> 5 - 20% and MgO being 15% or less and \*\*\*\* temperature up refinement are in a condition which made carbon concentration in molten steel 1% or more. By carrying out controlling molten steel temperature at 1500-1700 degrees C, the reduction recovery of the part for chromium in decarbonization slag can be carried out much more efficiently.

[0010] Furthermore, if the aforementioned slag heat retaining temperature is made into 1400-1500 degrees C, an erosion of refractories can be controlled completely, is stabilized more and can attain sufficient effect.

[0011]

[Function] The production process of this invention is shown in drawing 1 . the reduction production process according [ a production process 1 ] to the charcoal material addition after tapping -- a production process 2 -- the insertion production process to the converter of dephosphorization / desulfurization molten iron -- a production process 3 -- a temperature-programmed-reduction production process -- in a production process 4, a production process 5 shows the dissolution production process of decarbonization and a ferrochrome alloy, and a production process 6 shows a tapping production process for a middle waste production process. For the slag after charcoal material reduction termination, and 3, as for a converter and 5, in drawing 1 , melted iron (molten iron thru/or molten steel) and 4 are [ the decarbonization slag which generated 1 by front charge and 2 / the slag collected / chromium / and 6 ] decarbonization slag. Thus, by adding charcoal material, performing the furnace swing of multiple times, leaving in a converter the decarbonization slag generated by decarbonization of front charge, and mixing charcoal material with decarbonization slag The



temperature of decarbonization slag in the condition of having held at 1400-1700 degrees C, by reducing the chromic-acid ghost ( $\text{Cr}_2\text{O}_3$ ) concentration in decarbonization slag to 20% or less, and blowing oxygen a top, carrying out it, and burning charcoal material. The molten iron of degree charge of 1500 degrees C or less is inserted in, and while blowing oxygen a top, carrying out it next and performing a temperature up, the chromic-acid ghost in decarbonization slag is returned. Then, after tilting a converter and carrying out the waste of this chromium recovery part slag, while uprighting a furnace and being decarbonized by blowing oxygen a top and carrying out it, it is the production process which carries out addition dissolution of the ferrochrome alloy, and manufactures stainless steel rough molten steel. In addition, the converter mold reaction container as used in the field of this invention has pointed out the reaction container which makes a refinement means blowing by the oxidizing gas represented by a top-blown rotary converter and the raised bottom \*\*\*\* converter.

[0012] this invention persons are  $\text{Cr}_2\text{O}_3$ . As a result of considering wholeheartedly the reaction of a content slag and carbon saturation melted iron, it is  $\text{Cr}_2\text{O}_3$ . Even if the temperature of a content slag is 1400 degrees C or more and it has a fluidity, it is  $\text{Cr}_2\text{O}_3$ . By reducing concentration to 20% or less, about 1350-degree C molten iron could carry out the knowledge of a reaction hardly advancing. This invention is made based on this knowledge. That is, in the case of this invention, the big problem of bumping which considered generating of CO gas by reduction of a rapid iron oxide which occurs when molten iron is \*\*\*\*(ed) to the slag generated by plain steel decarbonization refinement as the cause does not arise at all, but for this reason, in the furnace which remained the generation slag of front charge, where reaction control is carried out, it can insert in molten iron.

[0013]  $\text{Cr}_2\text{O}_3$  The conditions for making quick reduction speed of the chromium from a content slag. That the reaction interface product between a slag/metal is large, i.e., maintain the rate of the liquid phase of a slag at a high order, and  $\text{Cr}_2\text{O}_3$  in a molten slag phase  $\text{Cr}_2\text{O}_3$  under keeping large the driving force of migration to a reduction reaction interface, i.e., a slag, Although it is that activity is high As shown in drawing 2, it is  $\text{Cr}_2\text{O}_3$ . As opposed to the case where concentration is about 25% or more It is  $\text{Cr}_2\text{O}_3$  in a slag that it is 20% or less. Activity is  $\text{Cr}_2\text{O}_3$  in the molten slag phase which it becomes 1/2 or less, and is the driving force of a reaction. It will originate in the activity difference in activity and a reaction interface product becoming small, and the reactivity between a slag/metal will fall remarkably. this --  $\text{Cr}_2\text{O}_3$  in a slag if concentration falls to 20% or less -- pure  $\text{Cr}_2\text{O}_3$  in solid phase disappearing --  $\text{CaO-Cr}_2\text{O}_3$   $\text{MgO-Cr}_2\text{O}_3$  etc. -- it is because formation of a multiple oxide serves as a subject. Therefore,  $\text{Cr}_2\text{O}_3$  When concentration is 20% or less, the reduction reaction of the chromium by molten iron hardly advances, but becomes avoidable [ generating of CO gas resulting from the rapid reduction reaction at the time of molten iron insertion, i.e., bumping, ].

[0014] However, if reduction of chromium does not advance in the \*\*\*\* reducing period after molten iron insertion (production process 3 in drawing 1), the fall of productivity etc. is caused and it is not practical. On the other hand, this invention persons are  $\text{Cr}_2\text{O}_3$ , if the temperature of both melted iron (molten iron and molten steel) and a slag is 1500 degrees C or more. Even when concentration was 20% or less, it discovered that a reduction reaction was promoted sharply. Drawing 3 is  $\text{Cr}_2\text{O}_3$ . Although it is the result of investigating the temperature dependence of the reduction reaction by the molten iron of a content slag, it is  $\text{Cr}_2\text{O}_3$ . Even when concentration is 20% or less, it turns out that reduction speed is increasing rapidly bordering on about 1500 degrees C. That is, since the temperature of the both sides immediately after molten iron insertion becomes that the temperature of insertion molten iron is 1500 degrees C or less, and slag temperature is 1700 degrees C or less with 1500 degrees C or less when the amount of survival in a furnace of the decarbonization slag which is usually operation within the limits is 100 to 500 (kg/ton-Pig) degree to the amount of insertion molten iron, bumping evasion will be possible.

[0015] Therefore, if this slag is made to coexist with molten iron and carries out a temperature up within a converter, after temperature rises, it is shown that the chromic-acid ghost in a slag is returned. The rate of the liquid phase of a slag improves remarkably that slag temperature is 1500 degrees C or more when  $2\text{OCr}_3$  concentration is 20% or less, the dissolution rate of the chromic-acid ghost to the inside of a molten slag phase becomes large, and this is  $\text{Cr}_2\text{O}_3$ . Since activity also rises, the reaction is promoted. However, as for a real operation top, in a hot case, the amount of erosions of refractories increases rapidly rather than 1700 degrees C.

[0016] Although evasion of bumping is possible, when productivity and the chromium yield are taken into consideration, in order for the reduction speed in a temperature-programmed-reduction production process to need to maintain to a high order as much as possible and to make this reduction condition

more advantageous in this invention, it is  $\text{Cr}_2\text{O}_3$ . Even if concentration is 20% or less, by control of a slag presentation, it is  $\text{Cr}_2\text{O}_3$  in a slag. It is necessary to maintain activity to a high order as much as possible. Reduction of the chromium from the slag which contains  $\text{Cr}_2\text{O}_3$  which generated this by decarbonization refinement of high chrome steel 25% or more is  $\text{Cr}_2\text{O}_3$  in a slag. Since activity is as high as 1, it says [ that a reaction rate is quick ], the chromic-acid ghost which exists in a slag --  $\text{Cr}_2\text{O}_3$  it is -- a sake -- easy -- the liquid phase -- inside -- it can dissolve -- since -- a macro ---like -- the liquid phase -- a rate -- increasing -- not making -- \*\* -- reduction -- being possible -- \*\* -- saying -- the fact -- the thing based on discovery -- it is . That is,  $\text{Cr}_2\text{O}_3$  The slag to contain is  $\text{Cr}_2\text{O}_3$ . The minute solid phase used as the principal component In order to be in the condition which exists innumerable in the liquid (molten slag phase) constituted with other oxides and to maintain the reduction speed of chromium to a high order setting solid phase to pure  $\text{Cr}_2\text{O}_3$  -- if it puts in another way --  $\text{CaO-Cr}_2\text{O}_3$   $\text{MgO-Cr}_2\text{O}_3$  etc. -- it is indispensable to hold a slag presentation on the conditions which are not formed as much as possible.

[0017] Among these,  $\text{MgO-Cr}_2\text{O}_3$  It is a principal component in a chrome ore, and when  $\text{MgO}$  concentration is too high also in decarbonization slag, in order to generate, it is necessary to make  $\text{MgO}$  concentration in decarbonization slag 15% or less. On the other hand, it is  $\text{CaO-Cr}_2\text{O}_3$ . It is  $\text{CaO/SiO}_2$  in order to generate, when the  $\text{CaO}$  concentration in a slag is too high. It is necessary to carry out to 3.0 or less. However,  $\text{CaO/SiO}_2$  When it is the range of 3.0-4.0, it is aluminum  $2\text{O}_3$ . By controlling concentration in 5 - 20% of range, it is  $\text{CaO-aluminum } 2\text{O}_3$ . In order to form the compound of a system, it is  $\text{CaO-Cr}_2\text{O}_3$ . It is possible to minimum-ize formation. However,  $\text{CaO/SiO}_2$  Even if it is 3.0 or less, it is aluminum  $2\text{O}_3$ . The case where concentration is less than 5%, and  $\text{CaO/SiO}_2$  4.0 super-\*\*\*\*\* and 20% or less of aluminum  $2\text{O}_3$ , at concentration, it is  $\text{CaO-aluminum } 2\text{O}_3$ . Since it is inadequate for formation of a system compound, it is  $\text{CaO-Cr}_2\text{O}_3$ . Formation will be promoted. Moreover,  $\text{CaO/SiO}_2$  The case where it is less than 1.0, and aluminum  $2\text{O}_3$  When concentration is 20% \*\*, since  $\text{MgO}$  solubility increases, a refractories erosion increases and is not practical.

[0018] Moreover, since the slag of each above-mentioned presentation has high viscosity, it does not add charcoal material superfluously but has the feature, SUROPPINGU [ \*\* ]. Therefore, it becomes possible to return blowing a top and advancing decarbonization of a steel bath by oxygen. By carrying out like this, since the total amount of decarbonization which let the reducing period and the decarbonization term pass decreases, productivity can be raised sharply. Although drawing 4 shows the relation between carbon concentration and reduction speed, by controlling a slag presentation on the above-mentioned conditions shows that there is sufficient reducing power, if carbon concentration is 1% or more.

[0019] By the way, it is necessary to carry out efficiently as much as possible from a viewpoint of productivity also with reduction by charcoal material addition of the decarbonization slag after tapping. Although it is fully securing a slag / charcoal material interface product as this condition by performing the furnace swing of multiple times after adding charcoal material in a converter, and securing sufficient temperature blowing a top and performing a reduction reaction by combustion of the charcoal material by \*\*\*\* Charcoal material reduction is performed [ that is, ] at an elevated temperature from 1700 degrees C. The slag temperature at the time of molten iron insertion to a 1700-degree-C super-\*\*\*\*\* case Reduction speed is  $\text{Cr}_2\text{O}_3$  even if, although a high order is maintainable. Even if it reduces concentration to 20% or less, since a local elevated-temperature portion exists at the time of molten iron insertion of degree production process, and bumping may be caused and the amount of erosions of refractories also increases, it is not practical. Conversely, if slag cooling is performed for bumping evasion, since a cooldown delay is needed, a failure will be produced for productivity. Moreover, the problem that the reduction speed itself becomes it late that the slag temperature at the time of molten iron insertion is less than 1400 degrees C will arise. Therefore, it is necessary to perform charcoal material reduction of the decarbonization slag after tapping in 1400-1700 degrees C. In addition, since between a slag/molten iron can serve as a reaction interface by making the molten steel after charge-before 1000kg / (ton-Slag) following tapping remain in a furnace, and performing this charcoal material reduction in addition to between a slag / charcoal material, reduction speed improves by leaps and bounds. However, if the residual amount of molten steel exceeds 1000kg/(ton-Slag), since there is nothing ( drawing 5 ), the tapping yield falls to reverse and the improvement effect of the reduction speed beyond it produces a failure for productivity, it is hardly practical.

[0020] Furthermore, since the local elevated-temperature (1500 degrees C or more) portion between slag metal may be formed also about insertion molten iron temperature as the residual slag temperature in a furnace is 1400 degrees C or more when the temperature exceeds 1500 degrees C, the danger of bumping is nonavoidable.

[0021]

[Example] The production process of an example is the same as that of drawing 1. After adding charcoal material from on a furnace to the 175t raised bottom \*\*\*\* converter which left in the furnace the decarbonization slag generated by decarbonization of front charge and performing the furnace swing of multiple times to it, while inserting in the molten iron of degree charge, blowing oxygen a top, carrying out it next and performing a temperature up, the chromic-acid ghost in decarbonization slag is returned (temperature-programmed-reduction term). Then, a converter is tilted, the waste of the slag of a part or most is carried out, and subsequently a furnace is uprighted, and oxygen is transmitted, adding a ferrochrome alloy and flux, and decarbonization refinement is carried out. After falling to the target carbon concentration, a furnace is tilted again, tapping only of the molten steel is carried out, and the slag containing a chromic-acid ghost is made to remain in a furnace. The molten steel which carried out tapping moves to a finish decarbonization production process, and it adds charcoal material from on a furnace to a converter, with a slag left. Here, a scrap may be used for the case where charcoal material and flux are used for a temperature-programmed-reduction term depending on thermal conditions or slag conditions, a temperature-programmed-reduction term, or an decarbonization term.

[0022] The example of the charcoal material reduction in this invention is shown in a table 1 with the example of a comparison. Test numbers 1-6 are the examples of this invention. On the other hand, although a test number 7 is the case that the slag temperature at the time of molten iron insertion is high, generating of bumping is seen and the erosion of refractories is also great. Moreover, heat retaining temperature is low, charcoal material reduction is inadequate, and a test number 8 is Cr 2O<sub>3</sub>. Although it is the case that concentration is high, although generating of bumping does not take place that insertion molten iron temperature is 1500 degrees C or less in this case, a subsequent temperature-programmed-reduction production process takes time amount, and a problem is produced for productivity. Furthermore, although a test number 9 and a test number 10 are the cases that insertion molten iron temperature is high, bumping has all occurred in these cases. Moreover, although a furnace swing is not performed although the heat retaining temperature of test numbers 11 and 12 is enough, but it is the case which was inadequate Slag temperature is high, and when the temperature of both a slag and molten iron after molten iron insertion exceeds 1500 degrees C, bumping occurs, and in the case where it is 1500 degrees C or less, in order to originate in reduction having not advanced at a charcoal material reducing period and for a subsequent \*\*\*\* reducing period to take a long time, a problem is produced for productivity.

[0023]

[A table 1]

[0024] What clarified efficient conditions more at the temperature-programmed-reduction term of this invention shown in drawing 1 is combined with the example of a comparison, and a table 2 shows it. Test numbers 13-21 correspond to the desirable conditions in the example of this invention. On the other hand, although 22 and 23 of a test number are the case where the basicity in decarbonization slag (CaO/SiO<sub>2</sub>) is low, and a high case, and it is satisfactory to the reduction itself in being low, since the solubility of MgO to the inside of a slag increases, the amount of refractories erosions increases. Conversely, when high, the solid phase in a slag is CaO-Cr 2O<sub>3</sub>. Since it becomes, it is Cr 2O<sub>3</sub>. Activity falls, and reduction speed does not improve but it is Cr 2O<sub>3</sub> at the time of temperature-programmed-reduction term termination. Concentration becomes high. Moreover, a test number 24 is aluminum 2O<sub>3</sub>. Although it is the case that concentration is high, and it is satisfactory to the reduction itself also in this case, increase of the amount of refractories erosions poses a problem. Furthermore, for a test number 25, although it is the case that MgO concentration is high, the solid phase in a slag is MgO-Cr 2O<sub>3</sub> also in this case. Since it becomes, it is Cr 2O<sub>3</sub>. Activity falls, and since reduction speed is low, it is Cr 2O<sub>3</sub> at the time of temperature-programmed-reduction term termination. Concentration becomes high. On the other hand, although it is the case where test numbers 26 and 27 have a high temperature at the time of temperature-programmed-reduction term termination, and a low case, and it is satisfactory to the reduction itself in being high, the amount of refractories erosions increases

remarkably. Conversely, since it originates in decline in the rate of the liquid phase of a slag and reactivity is checked when low, it is Cr 2O<sub>3</sub> at the time of temperature-programmed-reduction termination. Concentration becomes high. Moreover, although a test number 28 is the case where the carbon concentration in melted iron is 1% or less, it originates in the fall of reduction speed, and it is Cr 2O<sub>3</sub> at the time of temperature-programmed-reduction termination. It becomes high.

[0025]

[A table 2]

[0026]

[Effect of the Invention] Refinement of the efficient stainless steel which does not use an expensive reducing agent at all was attained without making a refractories erosion increase without causing bumping by using the decarbonization slag of front charge for blowing of degree charge in refinement with a converter mold reaction container by this invention.

[Claim(s)]

[Claim 1] By facing melted iron containing chromium carrying out decarbonization refinement with a converter mold reaction container, and supplying charcoal material in a furnace, while decarbonization slag containing a chromic-acid ghost generated by front charge had been made to remain in a furnace Chromic-acid ghost (Cr 2O<sub>3</sub>) concentration in decarbonization slag is made into 20% or less. And where heat retaining of the temperature of decarbonization slag is carried out to 1400-1700 degrees C, molten iron of degree charge of 1500 degrees C or less is inserted in. A manufacture method of stainless steel rough molten steel using decarbonization slag which carries out the waste of the slag collected [ chromium ], and is characterized by performing decarbonization refinement, dissolving a ferrochrome alloy at the same furnace succeedingly after carrying out \*\*\*\* temperature up refinement and returning a part for chromium in said decarbonization slag.

[Claim 2] By facing melted iron containing chromium carrying out decarbonization refinement with a converter mold reaction container, and supplying charcoal material in a furnace, while decarbonization slag containing a chromic-acid ghost generated by front charge had been made to remain in a furnace By making chromic-acid ghost (Cr 2O<sub>3</sub>) concentration in decarbonization slag into 20% or less, and spraying oxygen Burn charcoal material, and where heat retaining of the temperature of decarbonization slag is carried out to 1400-1700 degrees C, molten iron of degree charge of 1500 degrees C or less is inserted in. A manufacture method of stainless steel rough molten steel using decarbonization slag which carries out the waste of the slag collected [ chromium ], and is characterized by performing decarbonization refinement, dissolving a ferrochrome alloy at the same furnace succeedingly after carrying out \*\*\*\* temperature up refinement and returning a part for chromium in said decarbonization slag.

[Claim 3] A manufacture method of stainless steel rough molten steel using decarbonization slag according to claim 1 or 2 characterized by making molten steel of 1000kg / (ton-Slag) following remain in a furnace to 1t (decarbonization slag) of generation slags after front charge tapping.

[Claim 4] A component of decarbonization slag containing a chromic-acid ghost generated by front charge is CaO/SiO<sub>2</sub>. A manufacture method of stainless steel rough molten steel using 1.0-3.0, and decarbonization slag given in any 1 term of claims 1-3 characterized by MgO being 15% or less.

[Claim 5] A component of decarbonization slag containing a chromic-acid ghost generated by front charge is CaO/SiO<sub>2</sub>. 3.0-4.0, and aluminum 2O<sub>3</sub> A manufacture method of stainless steel rough molten steel using decarbonization slag given in any 1 term of claims 1-3 characterized by MgO being 15% or less 5 to 20%.

[Claim 6] \*\*\*\* temperature up refinement is the ingot method of stainless steel rough molten steel using decarbonization slag given in any 1 term of claims 1-5 characterized by carrying out controlling molten steel temperature at 1500-1700 degrees C where carbon concentration is made into 1% or more.

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und geht als metallisches Chrom in die Schmelze über. Anschließend erfolgt ein  
10 Zwischenabschlacken und ein erneuter Blasvorgang auf das Roheisen, wobei  
erneute Schlacke entsteht. Anschließend wird der Stahl abgestochen, und die  
Schlacke verbleibt für die nächste Chargierung im Behandlungsgefäß.

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Der Erfindung liegt die Aufgabe zugrunde, ein Verfahren zur Behandlung von  
legierten kohlenstoffhaltigen Eisenschmelzen zur Herstellung von Stahl so wei-  
terzuentwickeln, dass bei der Entkohlung der Verlust an den metallischen – teu-  
ren - Legierungselementen durch Verschlackung gering ist. Insbesondere soll  
die Verschlackung von Chrom bei chromhaltigen Schmelzen minimiert werden  
und der Rückgewinnungsgrad an metallischem Chrom hoch sein.

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Diese Aufgabe wird durch das Verfahren mit den Merkmalen des Anspruchs 1  
gelöst. Vorteilhafte Weiterentwicklungen sind in den Unteransprüchen be-  
schrieben.

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Erfindungsgemäß wird ohne Zwischenabschlacken die Schlacke mit den Metall-  
oxiden, die während mindestens drei bis vier hintereinander ablaufender Ent-  
kohlungsprozesse der Schmelze anfallen, gesättigt wird, wodurch aufgrund des  
zunehmenden Anteils an Metalloxiden in der Schlacke der Verschlackung der  
metallischen Legierungselemente zunehmend entgegengewirkt wird. Die Be-  
30 handlung findet ohne Zwischenabschlacken der Schlacke statt, die sich über  
mehrere Chargen an Roheisen und mehreren Abstichen an Stahlschmelze, an-  
sammelt. Da kein Zwischenabschlacken stattfindet, steigt die Konzentration der  
Metalloxide in der Schlacke, wobei eine zunehmende Konzentration einer Ver-  
schlackung mehr und mehr entgegenwirkt, d.h. die Tendenz zur Metalloxydation

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sinkt. Hierbei reichert sich die Schlacke pro Entkohlungsprozess nicht propor-  
tional an Metalloxiden an, sondern es wird vorteilhaft immer weniger pro Ent-  
kohlungsprozess verschlackt. Bei vollständiger

02.04.2004

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**Patentansprüche:**

1. Verfahren zur Behandlung von legierten kohlenstoffhaltigen Eisenschmelzen zur Herstellung von Stahl,  
wobei in einem metallurgischen Gefäß eine kohlenstoffhaltige Eisenschmelze einer Entkohlung durch Zugabe von Sauerstoff ausgesetzt wird und eine Teilmenge der metallischen Legierungselemente verschlackt, wobei die Metallschmelze aus dem metallurgischen Gefäß abgezogen wird, währenddessen die Schlacke unreduziert im metallurgischen Gefäß verbleibt und anschließend das metallurgische Gefäß mit einer neuen Charge Eisenschmelze befüllt wird und erneut ein Entkohlungsprozess durchgeführt wird,  
**dadurch gekennzeichnet,**  
dass ohne Zwischenabschlacken die Schlacke zunehmend mit Metalloxiden, die während mindestens drei bis vier hintereinander ablaufender Entkohlungsprozesse der Schmelze anfallen, gesättigt wird, wodurch einer Verschlackung der metallischen Legierungselemente zunehmend entgegengewirkt wird.
2. Verfahren nach Anspruch 1,  
**dadurch gekennzeichnet,**  
dass, nachdem der Sättigungsgrad oder ein annähernder Sättigungsgrad der Schlacke erreicht ist, die Schlacke reduziert wird und erst dann abgeschlackt wird.

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3. Verfahren nach Anspruch 1 oder 2,  
**dadurch gekennzeichnet,**  
dass während der Entkohlungsprozesse die Schlacke mit der Schmelze stark vermischt wird.

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4. Verfahren nach einem der Ansprüche 1 bis 3,  
**dadurch gekennzeichnet,**  
dass bei einer chromhaltigen Stahlschmelze die Schlacke mit Chromoxiden, die während der Entkohlungsprozesse aufgrund der Unvollständigkeit der Chromreduktion durch Kohlenstoff entstehen, zunehmend gesättigt wird und nach Erreichen eines Sättigungsgrades oder eines annähernden Sättigungsgrades die Schlacke mit Reduktionsmitteln für Chromoxid, insbesondere FeSi, reduziert wird und dann die reduzierte Schlacke abgestochen wird.

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5. Verfahren nach Anspruch 4,  
**dadurch gekennzeichnet,**  
dass aufgrund der Reduktion des Chromoxids in der Schlacke mit dem Kohlenstoff im Schmelzbad eine starke Rührwirkung entsteht.

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